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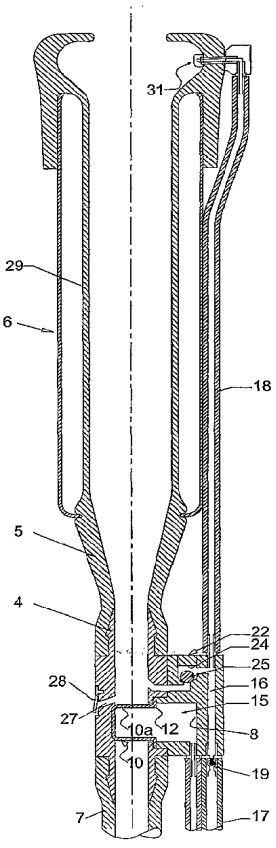

(57) Abstract: A valve device (1) for shutting off fluid flow from a teat cup to a milk tube located downstream of the teat cup, comprises a valve body (2) having a milk passageway (3) connectable at opposite ends to the teat cup and the milk tube by spigots (4), a valve chamber (8) in the valve body debouching into the milk passageway via an opening (9) in a wall of the passageway, a valve member (10) in the form of a cap-like flexible membrane disposed in sealing relating between the chamber (8) and the passageway (3), and a port (13) via which the valve chamber is selectively connectable to a source of fluid pressure or vacuum. The application of fluid pressure to the chamber (8) extends and/or expands the membrane (10) through the opening (9) into the milk passageway (3) so that it shuts off fluid flow therethrough and prohibits treatment fluid used to clean an animal's teats and the teat cup from entering the milk tube and contaminating the harvested milk. Upon completion of the cleansing process, vacuum is applied to the chamber (8) in order to return the membrane (10) to its unactuated position within the chamber.

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MILKING EQUIPMENT

The present invention relates to milking equipment and, more particularly, to a shut-off valve device for prohibiting treatment fluid, which is used to sanitise and/or cleanse animals' teats, teat cups and milk tubes, post-milking, from entering the milk line and contaminating the harvested milk.

Conventionally, automatic milking equipment installed in a milking parlour comprises a milking point at each animal stall within the parlour. Each milking point includes a milking cluster of teat cups for connecting the equipment to the teats of an animal to be milked. In the case of cows, for example, each milking cluster has four teat cups. Each teat cup comprises a hollow shell supporting a flexible liner which has a barrel portion for engaging about a teat and, at its upper end, has a head portion with a mouth through which the teat is engaged with the barrel of the liner. At the opposite, discharge end of the teat cup, the liner communicates with a flexible, short milk tube connected to a, so called, clawpiece of the cluster where the milk extracted from the animals teats is collected and delivered, via a flexible, long milk tube, to the collection vessel of the equipment. Upon commencement of milking, a vacuum is applied to the teat cups, via the long milk tube, the clawpiece and the short milk tubes, for the purposes of extracting milk from the teat cups. This vacuum also leaks between the barrel of the liner and the engaged teat and is applied to a void formed about the teat in the head of the liner in order to capture the cup on the teat. Milking is achieved by automatically and alternately applying vacuum and atmospheric pressure pulses to the space between the shell and the liner of each teat cup in order to flex the liner and stimulate discharge of milk from the engaged teat. The clawpiece includes a distributor for distributing the pneumatic pulses to the individual teat cups, via flexible pneumatic lines, as well as for distributing disinfectant and other treatment fluid, water and compressed air to the individual teat cups for the purposes of treating and cleansing the teats and teat cups.

After completion of a milking cycle, the milking cluster at each milking point is withdrawn from the teats (commonly referred to as "take-off") such as by an automatic cluster remover, and the teat cups are flushed internally with disinfectant and water and are dried with compressed air. These treatment fluids may be supplied to each teat cup via a flush valve connecting the short milk tube to the discharge end of the teat cup or via an injection nozzle in the head portion of the teat cup. Upon take-off, the milking cluster is designed to enable the short milk tubes to fall away from the centre line of the cluster so that the teat cups are inverted and hang with their heads downwardly from the claw piece in a rest position. Flushing is performed with the teat cups in this rest position. Consequently, liquid can escape through the head portions of the teat cups. Also, after milking, animal's teats are typically automatically or manually dipped, sprayed or otherwise treated with a disinfectant and conditioning fluid, such as, iodine or chlorohexadine and an emollient. For example, the teats may be treated automatically with fluid injected within the liner of the teat cup. In both cases where the teats are treated with fluid and the teat cups are flushed, there is a risk that the treatment fluids used may contaminate the harvested milk if they are not physically prevented from entering the short milk tube.

EP-A-1 328 148 discloses a device for automatically cleansing the teats of an animal and the teat cups upon take-off and for physically prohibiting the ingress of the treatment fluids into the associated short milk tube and contaminating the harvested milk. It comprises a valve device which is fitted in place of the conventional flush valve connecting the discharge end of the teat cup to its short milk tube. This valve device has a valve member slidable transversely to a valve passageway coupling the teat cup to the short milk tube so as to shut off fluid flow through the valve passageway. The valve member includes a nozzle which can communicate with the valve passageway for discharging cleansing fluid through the valve passageway into the teat cup. The nozzle is in communication with an internal passageway in the valve member which is selectively connectable to a supply of sanitising fluid for cleansing the teat, as the teat cup is being removed, and water and compressed air for back flushing the removed teat

cup, whilst the valve member is actuated to shut off fluid flow through the valve passageway. This valve device is complex, expensive to manufacture and is prone to being damaged by rough treatment.

It is an object of the present invention to provide an improved shut-off valve for preventing entry of treatment fluid into the milk line, with consequent contamination of the harvested milk, when, subsequent to milking, treatment fluid is injected manually or automatically into a teat cup to cleanse the teat of an animal and/or the teat cup.

To this end, the present invention consists in a shut-off valve device for milking equipment, comprising a valve body having a passageway therethrough connectable in a milk flow line and a valve chamber debouching into the passageway via an opening in a wall of the passageway, a valve member disposed in the valve chamber, and means for connecting the chamber to a source of fluid pressure, whereby the application of fluid pressure to the chamber moves the valve member through the opening into the passageway so as to shut off fluid flow therethrough, characterised in that the valve member is a flexible membrane which is disposed in sealing relation between the valve chamber and the passageway and which, upon the application of fluid pressure to the chamber, is adapted to extend and/or expand through the opening into the passageway so as to shut off the fluid flow therethrough.

The valve device of the invention may be arranged to shut off fluid flow from a teat cup of a milking cluster into its associated short milk tube. In this case, the passageway in the valve body has opposite ends connected to the teat cup and the short milk tube, respectively. Alternatively, a valve device according to the invention may be connected in the long milk tube delivering milk from the clawpiece of a milking cluster to a central collecting vessel.

The invention enables a milk line to be closed between a teat cup and a short milk tube, or between a milking cluster and a central collection vessel, at the end of a milking cycle in order to prevent treatment fluid, which is injected into the associated teat cups for cleaning the animal's teats and flushing the liners of the teat cups, from entering the milk line and contaminating the harvested milk. The operation of the invention and the

selective supply of fluid pressure to the valve chamber in the valve body in order to shut-off fluid flow through the valve device may be fully automated, saving labour and allowing the operator to spend more time on premilking routines. Moreover, the invention is not prone to the problems associated with valves having slidable valve members for shutting off fluid flow through the milk tubes.

The invention also consists in milking equipment comprising a milking cluster having teat cups connected to the claw piece of the cluster by short milk tubes, in which each teat cup is connected to its associated short milk tube by a valve device constructed as described above.

When the invention is used with automatic milking equipment, in which the teat cups of a milking cluster are engaged with the teats of a cow, for example, a suitable control signal can be derived from the milking equipment at the end of the milking cycle, for example, in response to automatic cluster removal. The control signal can be used to initiate a post-milking cleansing cycle in which treatment fluid is injected into the void between the teat cup liner and the animal's teat and is transferred to the teat as the teat cup is removed. After take off, a further signal can be derived from the equipment in order to trigger a flushing unit which then back flushes the teat cup liner to remove traces of fluid and sterilise the teat cup for the next application. During this post-milking cycle, the application of fluid pressure to the valve chamber of the valve device actuates the membrane valve member to shut off fluid flow through the milk passageway of the device and prevent the treatment or cleansing fluids from entering the milk line. The cycle may be managed by suitably programmed electronics with the application of the treatment fluids being controlled by pneumatic valves or the like.

Preferably, the membrane valve member has a hat or cap-like shape which, in the unactuated position of the valve member, projects into the valve chamber with the cavity in the cap facing the passageway. Upon application of fluid pressure to the chamber, the cap-shaped valve member is turned inside out so as to project across the passageway in sealing relation with the wall or walls of the passageway.

The membrane valve member may be formed from elastomeric material. The valve chamber may be connectable to a source of vacuum, upon removal of the fluid pressure from the valve chamber, to assist in returning the membrane valve member to its unactuated position within the valve chamber.

When milking is terminated and take-off is initiated, fluid pressure is applied to the valve device(s) to shut off fluid flow therethrough, until flushing of the teat cups is terminated, and when take-off is complete, the heads of the teat cups hang downwardly with respect to the claw piece of the milking cluster so that any remaining fluid can drain through the heads of the teat cups. The positioning and tensioning of the fluid supply tubes connected to the valve devices may be designed so as to urge the short milk tubes to fall away from the centre line of the cluster and hang down with respect to the claw piece. Preventing the teat cups from falling over the claw piece ensures that any treatment fluid remaining within a teat cup drains through the heads of the teat cups.

However, as a safeguard, in case a teat cup becomes entangled upon take-off and is caught with its head uppermost, so that treatment fluids cannot drain downwardly through the head of the teat cup, the valve device may have a drain port, controlled by a non-return valve, on the upstream side of the membrane valve member for enabling trapped fluid to drain from the space above the valve member when this is in the shut-off position. The non-return valve, which is conveniently a flap valve mounted on the valve body at the external end of the drain port, will normally be retained in the closed position, during the milking cycle, by vacuum applied through the milk line to extract milk from the teat cup. When this vacuum is removed and the shut-off valve device is actuated during the post-milking cleansing cycle, the flap valve will permit most of the treatment fluid to drain from the teat cup and the valve device, through the drain port, should the teat cup not hang downwardly.

In a preferred embodiment, the shut-off valve device also includes a flushing nozzle directed into the milk passageway upstream of the membrane valve member, and means for connecting the nozzle to sources of cleansing

and drying fluid. Where the device is intended for connecting a teat cup to its short milk tube, this avoids the need for a separate flushing device to be connected between the discharge end of the teat cup and the shut-off valve device. Where a teat cup is constructed so as to inject treatment fluid into the head of the teat cup liner and onto a teat engaged by the teat cup, such as described in my copending application No PCT/GB2004/004343, the means for connecting the flushing nozzle to a source of treatment fluid, may comprise a control valve, for example, a gravity controlled ball valve, which permits flushing fluid to flow to the nozzle when the teat cup is in the inverted position it assumes when disengaged from a teat. The ball valve will normally be retained in the closed position by vacuum applied through the milk line during the milking cycle. When the vacuum is removed and the post-milking treatment cycle begins, the valve ball, which initially falls on to its valve seat under the action of gravity, will be urged against the seat by the pressure of treatment fluid in the delivery tube supplying the control valve. However, after takeoff, and when the teat cup falls into its inverted position, the valve ball falls away from its seat to open the valve and enable flushing fluid to flow through the ball valve and to be injected into the discharge end of the teat cup by the flushing nozzle.

The above arrangement for controlling the supply of teat treatment fluid to the head of a teat cup and flushing fluid to the discharge end of the cup may be used independently of the shut-off valve device. Accordingly, the invention further consists in a flushing unit comprising a body having a milk passageway connectable at opposite ends to the teat cup and a milk tube, respectively, and a treatment fluid passageway having an inlet end connectable to a source of teat treatment or back flushing fluid and an outlet end connectable to a delivery tube for supplying teat treatment fluid to the teat cup, a flushing nozzle directed into the milk passageway, and valve means connecting the nozzle to the treatment fluid passageway, said valve means being operable to prevent teat treatment fluid from flowing to the flushing nozzle, when the teat cup is engaged with a teat, whilst permitting fluid to flow to the nozzle when the teat cup is disengaged from the teat and in an inverted position.

In order that the present invention may be more readily understood, reference will now be made to the accompanying drawings, in which:-

Figure 1 is an axial section through a teat cup embodying a shut-off valve device according to the invention, the valve device being shown in an unactuated condition,

Figure 2 is a view similar to Figure 1 showing the valve device in an actuated condition,

Figure 3 is a view similar to Figure 2 showing the teat cup and valve device in the inverted position which they assume after take-off,

Figures 4 and 5 are axial sections of a second embodiment of the invention,

Figures 6 and 7 are axial sections similar to Figures 4 and 5 and showing a modification, and

Figures 8 and 9 are axial sections similar to Figures 1 and 2 illustrating a third embodiment of the invention.

Throughout the various Figures like reference numerals are used to denote similar parts.

Referring to Figures 1 and 2 of the accompanying drawings, the shut-off valve device 1 according to the invention comprises a valve body 2 having a milk passageway 3 therethrough. Opposite ends of the milk passageway terminate in spigots 4 for coupling the milk passageway to the discharge end 5 of a teat cup 6 and a short milk tube 7 connecting the teat cup to the claw piece (not shown) of a milking cluster. The valve body 2 has a cylindrical valve chamber 8 which extends to one side of the milk passageway and which debouches into the latter via a circular opening 9. A valve member 10 moulded from flexible membrane material, such as, rubber, silicone or other elastomeric material, forms a seal between the chamber 8 and the passageway 3 at or adjacent the opening 9. The membrane valve member 10 is moulded in a cylindrical cap-like shape, for example, in the shape of a top hat, with its cap portion 10a projecting into the chamber 8 and the cavity in the cap portion facing the milk passageway, when in the unactuated position shown in Figure 1. This valve member is retained in position by an outwardly projecting annular flange 12 of the cap, about the mouth of its

cavity, which flange is trapped between interfitting parts of the valve body to form a seal between the valve chamber 8 and the milk passageway 3. The valve chamber is selectively connectable to a source of pneumatic pressure or vacuum for controlling the valve member 10 via a port 13 in the wall of the chamber which has its external end connected to a pneumatic tube 14 for coupling the port to the source of pneumatic pressure or vacuum. A pressure sensor 15 monitors the pressure in the valve chamber 8 for detecting possible malfunction of the membrane valve member. A recess 11 is formed in the internal wall of the milk passageway 3 opposite the valve chamber 8 for locating the project end of the valve member 10 when the latter is extended across the passageway in its actuated condition.

Formed through the valve body generally parallel to the milk passageway 3 is a treatment fluid passageway 16 having its opposite ends connected to a treatment fluid supply tube 17 and a delivery tube 18 for supplying the treatment fluid to the head of the teat cup 6. The fluid supply tube 17 is connected to the passageway 16 via a pressure actuated control valve 19 controlled by the fluid pressure within the tube 17, and to the delivery tube 18 via a restrictor 20 for regulating the flow ratio between the supply of treatment fluid to the delivery tube 18 and a back flushing nozzle 21.

The nozzle 21 is inclined to the axis of the milk passageway 3 and is connected, via a gravity-controlled ball valve 22, to a port 23 coupling the ball valve to the treatment fluid passageway 16. The ball valve 22 comprises a valve chamber 24, a valve ball 25 and a valve seat 26. The valve seat is connected to the back flushing nozzle 21 via the valve outlet port, and the valve chamber 24 is connected to the port 23. The valve ball is freely movable within the valve chamber 24.

Formed through the wall of the valve body 2 opposite the back flush nozzle 21 and immediately upstream of the location recess 11 in the internal wall of the milk passageway is a drain port 27 for enabling fluid trapped by the shut-off valve to drain from the valve. This port is controlled by a non-return flap valve 28 mounted on the valve body at the external end of the drain port 27.

The spigot 4 at the inlet end of the milk passageway 3 is an interference fit in the discharge end 5 of the flexible liner 29 of the teat cup 6 in order to couple the valve device to the teat cup. By way of example, the teat cup 6 illustrated in the drawings is constructed as described in my copending application No PCT/GB2004/004343 and comprises the liner 29, a hollow shell 30, which surrounds and supports the flexible liner, and a nozzle 31 for injecting teat treatment fluid into the head 39 of the liner and onto a teat engaged by the cup. The nozzle 31 is connected to a source of treatment fluid by the delivery tube 18, the treatment fluid passageway 16 and the supply tube 17. Because the treatment fluid is injected into the head of the liner 29 prior to removal of the cup from the teat, the teat is coated immediately after milking, giving protection before the teat is exposed to the environment, and the treatment fluid is wiped down the teat as the teat cup is removed.

Each teat cup 6 of a milking cluster is fitted with a shut-off valve device 1 between its discharge end 5 and the short milk tube 7 connecting the teat cup to the claw piece of the cluster. The claw piece serves to distribute air, vacuum and treatment fluid to the tubes 14,17. When the teat cups are attached to the teats of a cow for milking, the teat cups are generally in the position illustrated in Figures 1 and 2, with their heads 39 uppermost. Milking is stimulated by automatically and alternately applying vacuum pressure pulses to the space between the shell 30 and the liner 29 of each teat cup, via a suitable pneumatic line (not shown) served from the claw device. During the milking cycle, the valve device 1 is in the open position, as illustrated in Figure 1, and milk is extracted from each teat cup via the associated valve device and the short milk tube 7 by vacuum applied through the claw device. This vacuum retains the non-return flap valve 28 in the closed condition so that milk cannot bleed through the drain port 27. The valve ball 25 of the ball valve 22 initially falls, under the action of gravity, onto its valve seat 26 and is also retained in this position by the vacuum so that the ball valve is closed and prevents the ingress of milk into treatment fluid passageway 16. At this stage, there is no supply of teat treatment fluid to the

supply tube 17, the pressure valve 19 is closed and the membrane valve member 10 is in the unactuated position shown in Figure 1.

Upon termination of the milking cycle and automatic initiation of the fluid treatment and take-off cycle, fluid pressure is supplied to the pneumatic tube 14 to actuate the membrane valve member 10. As illustrated in Figure 2, upon the application of pressure, the valve member is turned inside out so as to project across the milk passageway and is expanded or inflated so as to seal with the recess 11. This blocks the milk passageway 3 and shuts off fluid flow therethrough. The pressure sensor 15 connected to monitor the membrane valve member 10 senses whether or not the valve member has operated correctly. If it has not, the associated milking cluster will be shut down in conjunction with the actuation of an alarm. Thereafter, teat treatment fluid is introduced under pressure into the fluid treatment tube 17. It opens the pressure valve 19 and flows through the restrictor 20 into the head 39 of the liner 29 via the nozzle 31, which applies the treatment fluid to the animal teat for a predetermined period. During this period, the valve ball 25 is held on its seat by the fluid pressure to prevent the treatment fluid being injected through the back flush nozzle 21. Because vacuum is no longer applied, when the pressure in the milk passageway 3 above the extended membrane valve 10 returns to atmospheric pressure, the flap valve 28 is free to open. This provides the facility for any fluid to drain away, if the teat cup is prevented from falling over upon take-off and is held in a partially upright position. The injection of treatment fluid, via the nozzle 31, is continued as the teat cup 6 is withdrawn from the teat and is wiped down the treat as the teat cup is removed. When the supply of treatment fluid to the nozzle 31 is terminated, the valve ball is no longer urged onto its seat by the fluid pressure and is free to move within the valve chamber.

As the teat cup 6 is removed from the teat upon take-off, the milking cluster is designed so that the teat cup naturally falls, together with the short milk tube 7, into an inverted position, with its head downwardly, as illustrated in Figure 3. The valve ball 25 is free to move from its seat 26 under the action of gravity, as the teat cup is inverted, and the ball valve 22 is opened. After a predetermined time delay, flushing liquid is injected into the supply

tube 17, valve 19 is lifted off its seat, and this liquid flows through the open valve 22 to the back flushing nozzle 21 which injects the liquid into the inside of the liner 29 to clean the latter. A portion of the flushing liquid is allowed to flow past the restrictor 20 and flush clean the delivery tube 18 and treatment nozzle 31. Clean compressed air is then injected through the tube 17 to dry the liner, delivery tube and nozzle. It will be apparent that the ball valve 22 is so constructed that, if the teat cup falls in an unintended way on take-off and ends up laying across the claw piece of the milking cluster, the valve ball 25 is still dislodged from its seat to allow the flushing fluids to flow through the valve to the back flushing injector nozzle 21.

When the back flushing operation is terminated, vacuum is applied to the tube 14 in order to return the membrane valve into the valve chamber 8 and open the shut-off valve. After take off, it is also standard practice to position the cluster of teat cups in an inverted position on a cleaning jetter so as to thoroughly wash the milk tubes by circulating cleaning liquid through the tubes. The cleaning liquid is drawn into each teat cup 6 by the vacuum system of the milking equipment, washing the liner 29 and membrane valves 10 internally. Also, the system vacuum causes the cleaning liquid to enter the nozzle 31 and flow through the delivery tube 18 to exit via the ball valve 22 and back flushing nozzle 21, the valve ball 25 being held open by gravity as this washing takes place.

The embodiment of the shut-off valve device illustrated in Figures 4 and 5 is constructed and operates similarly to the first embodiment described above except that this second embodiment is intended to be used with milking equipment where separate flexible delivery tubes respectively supply treatment fluid to the head of the teat cup and the back flushing nozzle in the shut-off valve. This is instead of supplying treatment fluid to the head of the liner via a common treatment fluid passageway 16 in the shut-off valve, as shown in the first embodiment. In this second embodiment, the back flushing nozzle 21 is supplied with treatment fluid via a dedicated passageway 40 in the valve body 2. The treatment fluid passageway 40 has its inlet end 41 connected to a treatment fluid supply tube and its discharge end connected to the nozzle 21 via a pressure actuated valve 42 which is a spring controlled

ball valve normally preventing leakage of treatment fluid into the milk passageway 3. As in the first embodiment, the back flushing nozzle is inclined to the axis of the milk passageway so as to direct flushing or rinsing fluid towards the interior of the liner 29 of the teat cup.

In the modification illustrated in Figures 6 and 7, the pressure actuated valve 45 connecting the treatment fluid passageway 40 to the back flushing nozzle 21 is of modified design. Instead of being a spring controlled ball valve, the valve is formed by a pair of resilient lips 46 projecting into the nozzle from the discharge end of the treatment fluid passageway 40 with the free ends of the lips being resiliently urged into contact in order normally to shut-off fluid flow between the passageway and the nozzle. However, when the fluid in the passageway 40 exceeds a predetermined pressure, the lips are urged apart by the fluid pressure in order to permit fluid to flow from the passageway into the nozzle 21 for injection into the milk passageway.

The third embodiment illustrated in Figures 8 and 9 is of similar construction and operation to the first embodiment described above except for the omission of the back flushing nozzle 21 and associated control valve 22 which connects the fluid supply passageway 16 to the nozzle 21. This embodiment is intended for use with a teat cup of the type described in my aforementioned PCT application in which the teat cup serves the dual purpose of enabling treatment fluid to be discharged into the head 39 of the teat cup liner 29, via the nozzle 50, so as to coat the engaged teat with fluid during take-off and, also of enabling sanitising, washing and drying of the liner after take-off by the injection of fluid upwardly into the liner when the teat cup falls into its rest position with its head downwardly. In this third embodiment, the valve body 2 simply serves as a fixing point for the distal end of the delivery tube 18 for the injection nozzle 50. At its distal end, the delivery tube 18 is coupled to a fluid passageway 51 formed through the valve body and having its inlet end 52 connected to the fluid supply tube 17 connected to a valve control system for selectively connecting the nozzle to supplies of treatment fluid and compressed air. The inlet end 52 of the passageway includes a pressure differential responsive non-return valve, typically, a duct bill valve, which prevents a higher vacuum occurring within

the head of one teat cup, as a result of vacuum applied for extracting milk, from effecting the vacuum in another one of the cups, when there is a difference in the degree of vacuum occurring within the heads of the teat cups.

Whilst particular embodiments has been described, it will be understood that modifications can be made without departing from the scope of the invention as defined by the appended claims. For example, the valve body 2 may be close coupled to or be integral with the shell 30. Also, instead of connecting a shut-off valve device of the invention between the discharge end of each teat cup and its short milk tune, a single such valve device including a back flush nozzle 21 may be connected into the long milk tube delivering milk from a milking cluster to a central collecting vessel. For ease of actuating the cap portion 10a of the membrane valve member 10 may be of frusto conical shape.

CLAIMS

1. A shut-off valve device (1) for milking equipment, comprising a valve body (2) having a passageway (3) therethrough connectable in a milk flow line and a valve chamber (8) debouching into the passageway (3) via an opening (9) in a wall of the passageway, a valve member (10) disposed in the valve chamber, and means (13,14) for connecting the chamber to a source of fluid pressure, whereby the application of fluid pressure to the chamber (8) moves the valve member through the opening (9) into the passageway (3) so as to shut off fluid flow therethrough, characterised in that the valve member is a flexible membrane (10) which is disposed in sealing relation between the valve chamber (8) and the passageway (3) and which, upon the application of fluid pressure to the chamber, is adapted to extend and/or expand through the opening (9) into the passageway so as to shut off the fluid flow therethrough.

2. A device as claimed in claim 1, wherein the membrane valve member (10) has a cap-like shape and, in its unactuated position projects into the valve chamber (8) with the cavity in the cap facing the opening (9), whereby the application of fluid pressure to the chamber (8) turns the cap-like membrane inside out so as to project it across the passageway in sealing relationship with the wall or walls of the passageway.

3. A device as claimed in claim 1 or 2, wherein the valve chamber (8) is connectable to a source of vacuum upon removal of fluid pressure from the chamber, whereby to return the valve member (10) to its unactuated position within the valve chamber.

4. A device as claimed in claim 1, 2 or 3, including a drain port (27) on the upstream side of the valve member (10) for enabling trapped fluid to drain from the passageway (3) from above the actuated valve member, said drain port being controlled by a non-return valve (28).

5. A device as claimed in claim 4, wherein the non-return valve is a flap valve (28).

6. A device as claimed in any one of the preceding claims, including a nozzle (21) directed into the passageway (3) upstream of the valve member

(10), and means (16,22; 40,42; 40,45) for connecting the nozzle to a treatment fluid supply conduit (17).

7. A device as claimed in claim 6, wherein the means for connecting the nozzle (21) to the fluid supply conduit (17) comprises a valve (22,42,45) which controls fluid flow to the nozzle.

8. A device as claimed in claim 7, wherein the valve is a gravity controlled ball valve (22) which is configured to permit fluid to flow to the nozzle (21) when an inlet end of the passageway (3) is directed downwardly.

9. A device as claimed in claims 6, 7 or 8, wherein the nozzle (21) is inclined to the axis of the passageway (3) so as to direct injected fluid towards an inlet end of the passageway.

10. A device as claimed in any one of the preceding claims, wherein the passageway (3) terminates at opposite ends in spigots for enabling the device to be connected into a milk tube (7) or between a teat cup (6) and a milk tube (7).

11. A device as claimed in any one of the preceding claims, wherein the membrane valve member (10) is formed from elastomeric material.

12. A device as claimed in any one of the preceding claims, including a pressure sensor (15) for monitoring pressure in the valve chamber (8)

13. A milking cluster comprising a plurality of teat cups (6), a plurality of short milk tubes (7) respectively connecting the discharge ends (5) of the teat cups to a claw piece for collecting milk discharged from the teat cups and a plurality of shut-off valve devices (1) as claimed in any one of the preceding claims respectively connecting the discharge ends of the teat cups to the short milk tubes.

14. Milking equipment comprising at least one milking cluster having a plurality of teat cups (6) and a plurality of short milk tubes (7) respectively connecting the discharge ends (5) of the teat cups to a claw piece which collects milk discharged from the teat cups, a long milk tube for delivering milk from the clawpiece to a central collection vessel of the equipment, and a shut-off valve device (1) as claimed in any one of the preceding claims having its passageway (3) connected in the long milk tube.

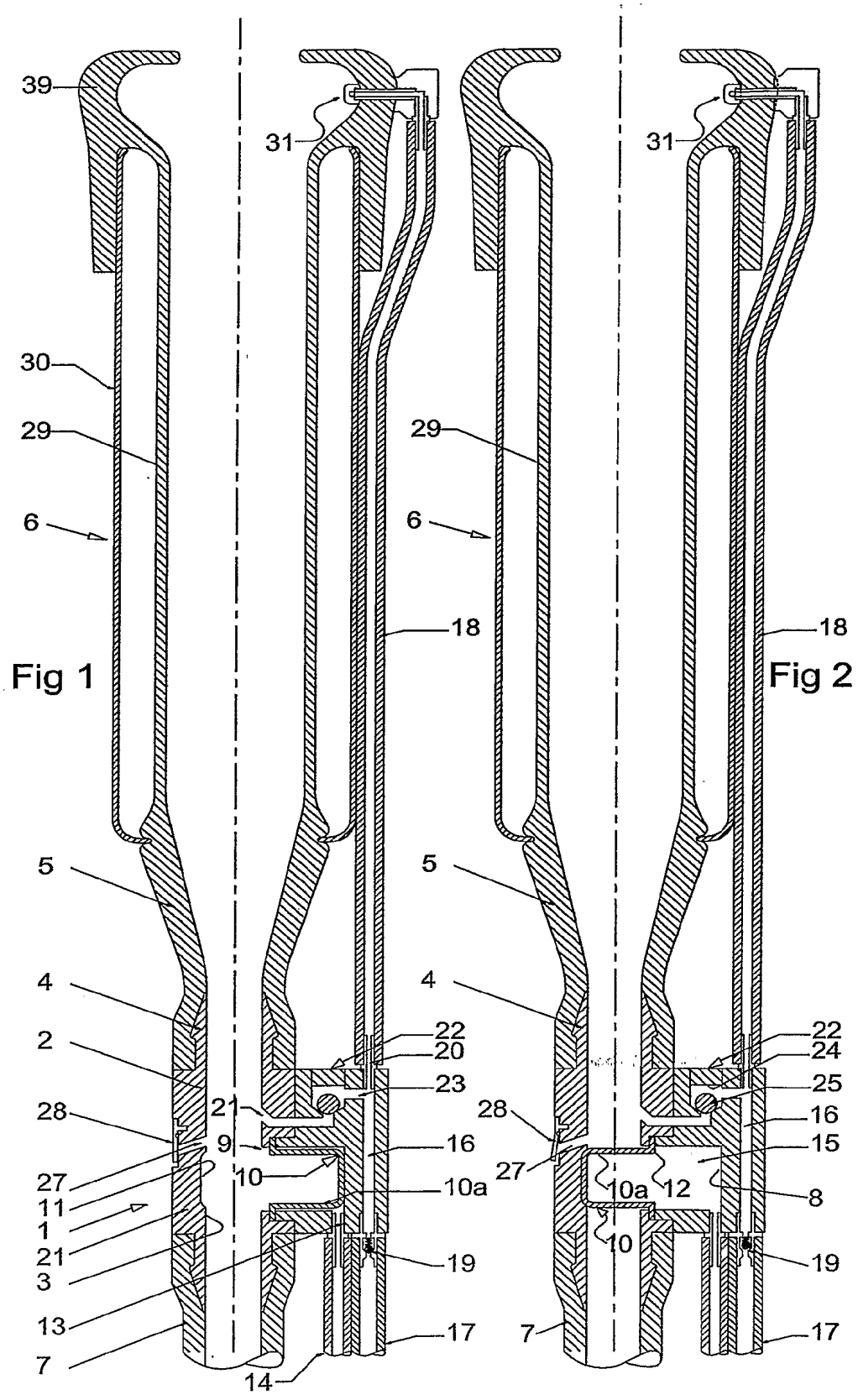
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Fig 1
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Fig 2

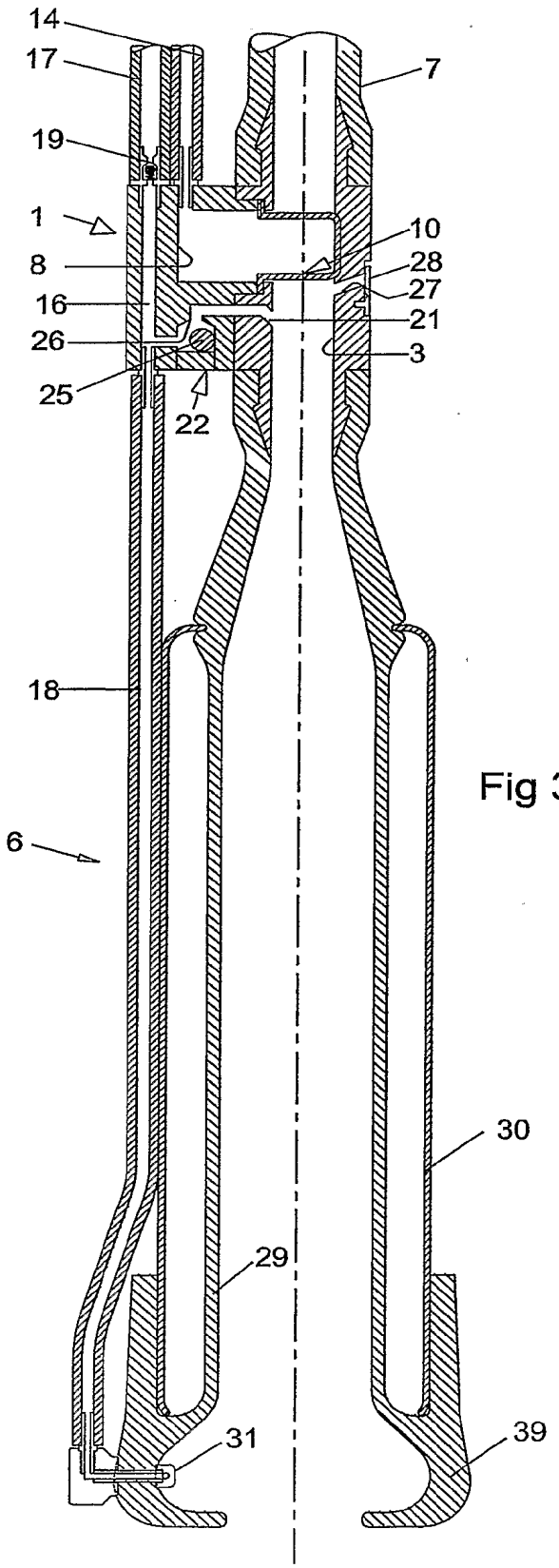

Fig 3

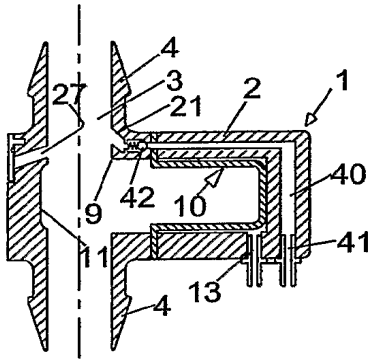

Fig 4

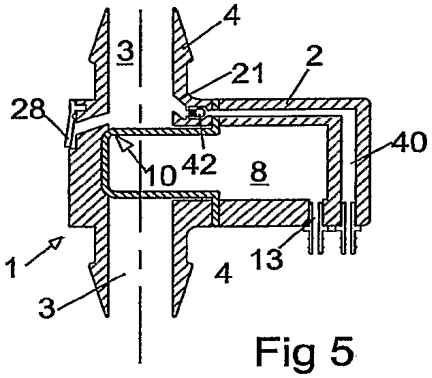

Fig 5

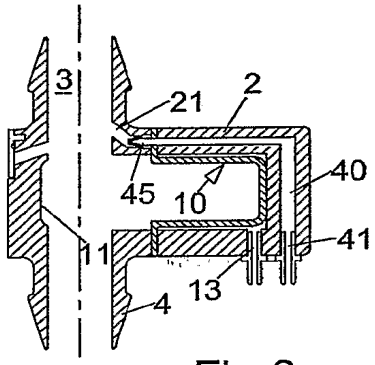

Fig 6

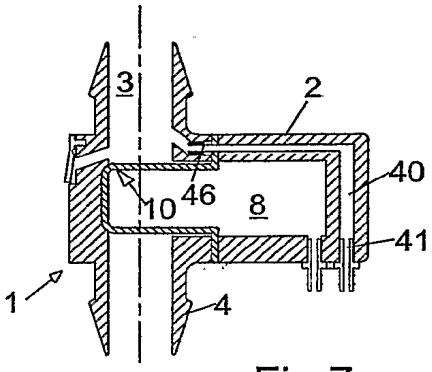

Fig 7

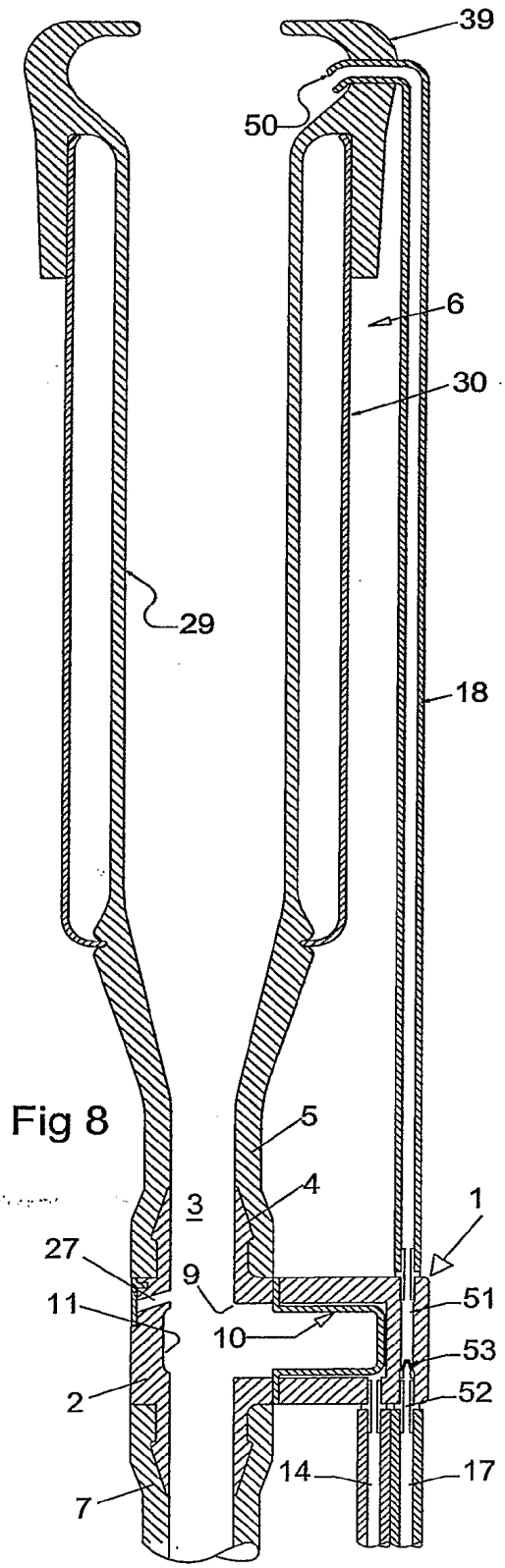
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Fig 8

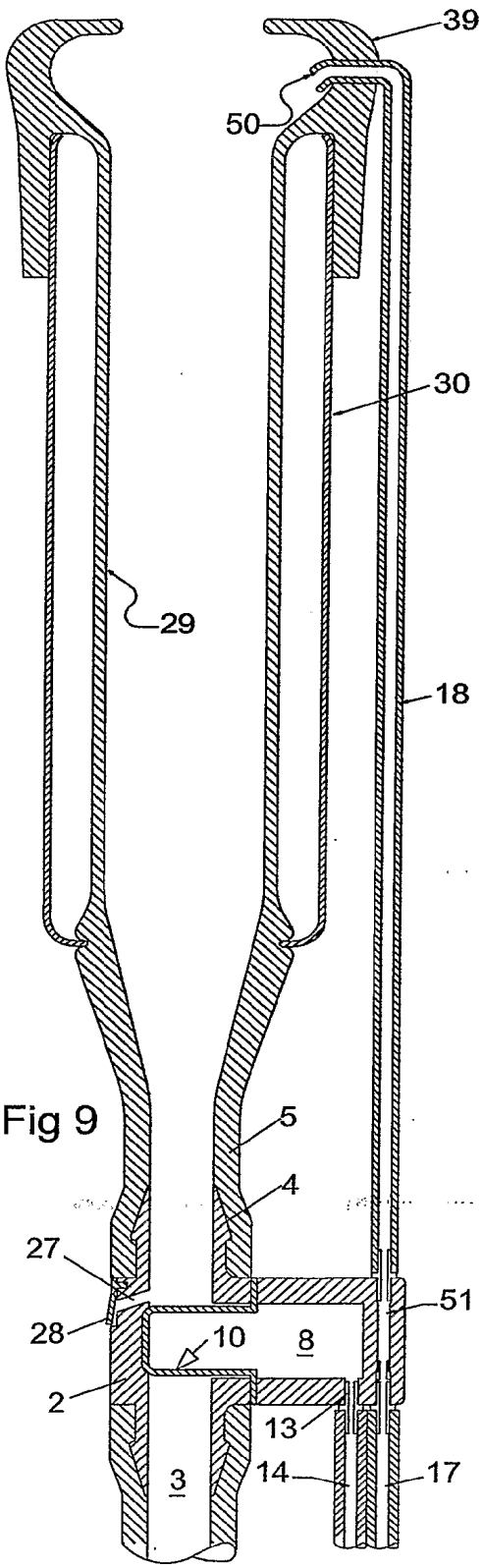
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Fig 9

INTERNATIONAL SEARCH REPORT

PCT/GB2005/000310

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A01J7/04 A01J7/02 F16K7/17

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A01J F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	AU 641 229 B2 (DOUGLAS HAROLD EMMINS) 16 September 1993 (1993-09-16) page 6 - page 7; claim 1; figures 1,2	1,2, 10-12 3-9,13, 14
X	DE 40 06 785 A1 (PASSAVANT-WERKE AG, 6209 AARBERGEN, DE) 6 September 1990 (1990-09-06) column 2; figures 1-3	1
Y	EP 1 328 148 A (RIEBERJO B.V) 23 July 2003 (2003-07-23) cited in the application paragraph '0116!; figures 1-5d	3,6-9, 13,14
Y	WO 01/17338 A (DELAVAL HOLDING AB; ERIKSSON, JAN) 15 March 2001 (2001-03-15) figures 1,2	4,5

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 May 2005	30/05/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Moeremans, B

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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